SYSTEM AND METHODS FOR PROTECTING PRINTER CONSUMABLES THROUGH POSITIONING NON-USE ZONES

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TECHNICAL FIELD

The present invention relates to consumable printer components and, more particularly, to the protection of consumable printer components through positioning designated non-use regions of these components in a manner which protects the remaining usable regions.

BACKGROUND

Printing devices such as printers, copiers, and facsimile machines, have replaceable components with limited life cycles during which the components are functional. When a component's life cycle ends, the component must be replaced. Examples of replaceable printing device components, often referred to as consumables, include paper, toner cartridges, ink cartridges, ribbon cartridges, fusers, photoconductors, drums, intermediate transfer belts, and the like. Consumables such as paper, toner and ink are consumed with each printed page because they make up the printed product. Other consumables such as fusers, photoconductors, and transfer drums or belts, are consumed with each page printed due to deterioration.

These latter consumable types are very sensitive and can be easily damaged through the general handling environment encountered, for example, while being handled during insertion into the printing device. In order to protect these consumables, they are generally enclosed within a cartridge or protective housing. However, their sensitive elements must be exposable to the external environment during the printing process so that they can accept and transfer image information or otherwise fulfill their function as designed within the printing process.

Therefore, the protective housing or cartridge which shields such consumables typically includes a gap through which the sensitive consumable element can be exposed. In order to limit this exposure, a movable protective mechanism such as a shutter is designed to cover the gap during times when the consumable item is not inserted within the printing device. Thus, while the cartridge containing the consumable is outside of the printing device, the protective shutter remains closed. When the cartridge is inserted into the printing device, a mechanism acts to open the shutter, exposing the sensitive consumable element in preparation for the printing process to begin.

Although this method of protecting consumable components works fairly well, the additional material and design costs associated with such shutter mechanisms increases the price consumers must pay to replace the consumable components. Thus, the cost of consumable components significantly increases the overall cost of ownership for printing devices. The use of shutter mechanisms to protect the sensitive consumable components serves to further increase the overall cost of ownership for various printing devices.

Accordingly, the need exists for a cost effective way of protecting sensitive consumable printing elements from harmful exposure in a general handling environment, while permitting the exposure of such elements as necessary to achieve their designed functionality in a printing process environment.

SUMMARY

Sensitive consumable components of printing devices are protected from harmful exposure to the environment and handling damage by designating regions of the components as non-use zones and consistently positioning the non-use zones toward exposure gaps in protective housings of the components during periods when the device is not printing.

Printers include one or more insertable consumable components that each have an image process surface. The consumable components are enclosed in protective housings that have an exposure gap. Printer control logic located either on the printer or on a host computer coupled to the printer, designates a region of the image process surface as a non-use zone. During periods when the printer is not printing, the printer control logic positions the non-use zone toward the exposure gap in the protective housing.

The printer control logic also designates a region of the image process surface as an image zone. During periods of printing, the image process surface translates past an exposure gap in the protective housing that encloses the consumable component. As the process surface translates past the exposure gap, image information is transferred to and from the image zone. The printer control logic operates to avoid transferring image information to a non-use zone during periods of printing.

Positioning the non-use zone of a consumable component toward the exposure gap when printing is complete, protects the image zone portion of the consumable by preventing its contact with the external environment through the exposure gap. The need for shutter mechanisms that cover exposure gaps and shield sensitive consumable elements from the general handling environment is therefore reduced. Reducing or eliminating shutter mechanisms from consumable cartridges or protective housings lowers design and manufacturing costs, thereby reducing the cost of replacing consumable components for printing devices.

BRIEF DESCRIPTION OF THE DRAWINGS

The same reference numbers are used throughout the drawings to reference like components and features.

Fig. 1 illustrates a workstation and a printer device as a suitable printer system in which zone-protected consumables may be implemented.

Fig. 2 is a block diagram illustrating a printer system such as that in **Fig. 1**.

Fig. 3 illustrates a printer device which employs various consumable components.

Fig. 4A illustrates an example of a zone-protected intermediate transfer belt to be used in a printer device such as the printer device of **Fig. 3**.

Fig. 4B illustrates an example of a zone-protected photoconductor to be used in a printer device such as the printer device of **Fig. 3**.

Fig. 4C illustrates an example of the zone-protected fuser assembly to be used in a printer device such as the printer device of **Fig. 3**.

Figs. 5A and **5B** illustrate an example of two zone-protected consumables in a single assembly which includes a photoconductor drum and an intermediate transfer belt.

Fig. 6 is a flow diagram illustrating an example method of protecting a consumable through designating and positioning a non-use zone.

DETAILED DESCRIPTION

Implementation of zone-protected consumables preserves the sensitive image-transferring capabilities of the consumables while in many cases permitting the elimination of protection mechanisms, such as shutters, that are otherwise necessary to cover exposure gaps in the protective housings of the consumables. Reducing the need for such shutter mechanisms reduces material and design costs associated with consumable print device components.

Exemplary Printer System for Zone-Protected Consumables

Fig. 1 illustrates an example of a printer system suitable for protecting print device consumables by designating and positioning non-use zones of the consumables. The system **100** of **Fig. 1** includes a printer device **102** connected to a host computer **104** through a direct or network connection **106**. Network connections **106** can include LANs (local access networks), WANs (wide area networks), or any other suitable communication link. The invention is applicable to various types of printing devices that make use of consumable components lending themselves to the designation and positioning of non-use zones as described herein below. Therefore, printer device **102** can include devices such as copiers, fax machines, scanners, and the like, and may also include multifunction peripheral (MFP) devices which combine the functionality of two or more peripheral devices into a single device.

In general, the host computer **104** outputs host data to the printer device **102** in a driver format suitable for the device **102**, such as PCL or postscript. The printer device **102** converts the host data and outputs it onto an appropriate recording media, such as paper or transparencies.

Fig. 2 illustrates the printer system **100** in more detail. The printer device **102** has a controller **200** that processes the host data. The controller **200** typically includes a data processing unit or CPU **202**, a volatile memory **204** (i.e., RAM), and a non-volatile

memory **206** (e.g., ROM, Flash). The printer device **102** includes a print engine **208** and one or more consumable printing components **210** that are protected through the proper positioning of a designated non-use zone. Consumable(s) **210** represent print device consumables that are consumed due to the wear and tear of the printing process, such as fusers, photoconductors, drums, and intermediate transfer belts. Other typical print device consumables that are consumed in the print process as part of the printed product, such as paper, toner and ink, are not illustrated in **Fig. 2.**

The controller **200** processes host data and manages the print process by controlling the print engine **208** and consumable(s) **210.** Printer control logic controls the print process through a printer device driver **212.** The device driver includes printer driver software **212** that is stored in memory **206** and executed on CPU(s) **202.** The printer driver software **212** includes a zone module that designates zones on consumables **210** and positions the zones to protect critical regions of the consumables **210,** as discussed more thoroughly below.

The host computer **104** includes a processor **214,** a volatile memory **216** (i.e., RAM), and a non-volatile memory **218** (e.g., ROM, hard disk, floppy disk, CD-ROM, etc.). The host computer **104** may be implemented, for example, as a general-purpose computer, such as a desktop personal computer, a laptop, a server, and the like. Although the printer device **102** typically stores and executes printer driver software **212** as discussed above, the host computer **104** may additionally implement one or more software-based printer drivers **220** that are stored in non-volatile memory **218** and executed on the processor **214** to configure data into an appropriate format (e.g., PCL, postscript, etc.) and output the formatted data to the printer device **102.**

Exemplary Print Process

Fig. 3 represents a color laser printer **300** as an example printer device **102** that may be used in the printing system **100** of **Figs. 1** and **2.** A general understanding of the

print process that takes place within printing devices such as printer **300** provides an appropriate context for appreciating the various implementations of zone-protected consumables presented below.

A typical color laser printer **300** produces an image using various colored toners. The ultimate application of the toners to a print medium is controlled by an electrostatic imaging process.

Color printer **300** houses four toner cartridges **302** in a rotating carousel **304** that is operational with a single photoconductor (OPC) drum **306**. The toner cartridges **302** represent the four main toner colors cyan (C), magenta (M), yellow (Y), and black (K). A four color image is built sequentially onto an intermediate transfer belt (ITB) **308** before it is finally transferred to the print medium (e.g., paper, transparency) in one pass.

To begin the imaging process, a primary charge roller (PCR) **310** within the OPC drum assembly **312** applies an electrostatic charge to the OPC drum **306**. As the OPC drum **306** rotates, a laser assembly **314** writes the latent image for the first color onto the drum **306** with laser **316**. The toner carousel **304** then puts the first color toner cartridge **302** into position for operation with the OPC drum **306**. Within toner cartridge **302**, an agitator (not shown) guides toner to a developer roller **318**. As the developer roller **318** and OPC drum **306** rotate, the toner is developed to the latent image electrostatically formed on the OPC drum **306**.

Each color image is thus developed one at a time on the OPC drum **306**. Also, each color image is transferred one at a time to the rotating ITB **308** because of attraction from electric charge on a primary transfer roller **320**. Once the four-color image has been built on the ITB **308**, the secondary transfer roller **322** is activated to attract the image away from the ITB **308** and onto the paper in one pass of the ITB **308** over the paper. The paper is guided by guide rollers **324** from a paper tray **326** or external source **328** past the ITB **308** and then through the fuser assembly **330**. The

fuser assembly **330** includes two hot rubber fuser rollers **332** which melt the toner, bonding it to the paper. From the fuser assembly **330**, the paper then exits the printer **300** into the output tray **334**.

Exemplary Implementations Of Zone-Protected Consumables

Figs. 4 and **5** illustrate zone-protected consumable components that can be used in print devices such as the color laser printer **300** of **Fig. 3**. **Figs. 4A**, **4B**, and **4C** illustrate respectively, an intermediate transfer belt (ITB) **308**, a photoconductor drum assembly **312**, and a fuser assembly **330**, such as those discussed above with respect to the print process of color laser printer **300**. **Figs. 5A** and **5B** illustrate a consumable assembly which includes both a photoconductor drum and an intermediate transfer belt.

Generally, the consumable components of **Figs. 4** and **5** have sensitive image process surfaces that are enclosed within a protective housing such as a cartridge. An image process surface typically covers the surface area of a rotating element within the protective housing. For example, the image process surface may cover the surface area of a rotating cylinder (i.e., a drum), or it may cover the surface area of a belt which rotates around two or more rollers. The protective housing has an exposure gap which permits access to the image process surface during the printing process. The rotating cylinder or belt translates the image process surface with respect to the exposure gap during printing, permitting the transfer of image information to and from the image process surface.

Figs. 4 and **5** illustrate details regarding the protective housings or cartridges which encase each of the zone-protected consumable components. The elements of the consumable components are enclosed in protective housings which have exposure gaps. As discussed, the exposure gaps facilitate the transfer of image information, such as electrostatic charge, a latent laser image, or a developed toner image, to and from the image process surfaces during printing. However, when consumable components are

removed from the print device, the exposure gaps will permit unwanted contact between the sensitive image process surfaces and the external handling environment if the gaps are not covered. Therefore, conventional housings protect the sensitive image process surfaces from the external handling environment through devices such as shutter mechanisms that are designed to cover the exposure gaps.

In **Fig. 4A**, an intermediate transfer belt (ITB) **308** is enclosed in a protective housing **400**. The protective housing **400** has an exposure gap **402** which notably lacks any mechanism for covering the gap **402**, such as a shutter mechanism. Thus, a region **404** of the sensitive process surface on the ITB **308** is exposed to the general handling environment when the assembly is removed from the printer device **300**. However, in accordance with this implementation, the region **404** has been designated as a non-use zone of the ITB **308**. Therefore, this region, or non-use zone **404** of the ITB **308**, will not be used during the printing process to transfer image information.

During a printing process, as the ITB **308** rotates around support rollers **406**, attracting color images off the OPC drum **306** (**Fig. 3**), the printing process skips over the non-use zone **404**. In addition, during periods of nonprinting the non-use zone **404** of the ITB **308** is positioned at the exposure gap **402**. Therefore, although a portion of the sensitive ITB **308** surface is susceptible to damage through the exposure gap **402** during times when the print device is not printing, the remainder of the ITB **308** surface is protected within the protective housing **400**. The portion of the ITB **308** surface susceptible to damage is non-use zone **404** that will not be used during the printing process to transfer image information. Only the protected portion of the ITB **308** surface is used as the image zone in a printing process, and the sensitive image transferring function of the ITB **308** is therefore preserved, despite the lack of a shutter mechanism to cover the exposure gap **402**.

Printer control logic generally controls the printing process and the designation and positioning of the non-use zone **404**. Specifically, printer driver software **212**

includes a zone module configured with an inherent understanding of the ITB **308**. The driver software **212** designates a non-use zone **404**, ensures that the non-use zone **404** is not used in transferring image information during printing periods, and positions the non-use zone **404** at the exposure gap **402** during nonprinting periods. In addition, the printer driver software **212** designates an image zone on the ITB **308** and controls the transfer of image information to and from the image zone during printing. The image zone is typically, but not necessarily, made up of the remaining portion of the ITB **308** that has not been designated as non-use zone **404**. Printer driver software **212** is typically stored in memory **206** on the print device **102** (**Figs. 1** and **2**), and executes on one or more resident processing units **202**. However, the printer driver software **212** may also be stored in memory **218** on a host computer **104** and execute on the host computer processors **214**.

With respect to each of the zone-protected consumables of **Figs. 4** and **5**, the repeatable positioning of non-use zones and image zones can occur in a variety of ways. For example, a particular position on the consumable can act as a home location which is sensed by a monitoring device on the printer or the consumable. All motions of the consumable and its zones are then coordinated from this home location. Consumables may also be equipped with an electronic memory device which stores the location of the non-use zone. The location of the non-use zone can then be transmitted to the printer upon inserting the consumable into the printer. The printer control logic would therefore designate the location transmitted from the memory device as the non-use zone.

It should be recognized that non-use zones for the zone-protected consumables described herein can be set by the printer, host computer, or at the factory where they are manufactured.

In a second implementation of a zone-protected consumable, **Fig. 4B** illustrates a photoconductor (OPC) drum assembly **312** enclosed in a protective housing **410**. The

protective housing **410** has an exposure gap **412** which has no shutter mechanism for covering up the gap **412**. As in the case of the ITB **308** of **Fig. 4A**, a region of the OPC drum **306** has been designated as a non-use zone **414** of the OPC drum **306**. Therefore, this non-use zone **414** of the OPC drum **306** will not be used during the printing process to transfer image information. During a printing process, as the OPC drum **306** rotates and receives latent color images written with a laser and developed with toner, the printing process skips over the non-use zone **414**. During non printing periods (e.g., at the end of a printing process), the non-use zone **414** of the OPC drum **306** is positioned at the exposure gap **412**. Therefore, although a portion of the sensitive OPC drum **306** surface is susceptible to damage through the exposure gap **412** during nonprinting periods, the image zone on the remainder of the OPC drum **306** surface is protected within the protective housing **410**, despite the lack of a shutter mechanism to cover the exposure gap **412**.

Designation and control of the non-use zone **414** of the OPC drum **306** is handled in the same manner as described above with regard to the ITB **308** of **Fig. 4A**. That is, printer control logic controls the printing process and the designation and positioning of the non-use zone **414**. Printer device driver software **212**, including a zone module, is stored and executes on either the printer device **102** or host computer **104**. The software **212** selects the non-use zone **414**, ensures that only the remaining image zone is utilized during each printing process, and consistently positions the non-use zone **414** at the exposure gap **412** during nonprinting periods, such as when a printing process is completed.

Fig. 4C illustrates a fuser assembly **330** enclosed in a protective housing **420**. In many print devices, the hot rubber fuser rollers **332** that melt the toner and bond it to the paper, have small diameters requiring the rollers to complete several full rotations in order to fuse each page. Fuser assemblies designed in this manner are less amenable to the zone-protection described herein, because it is not as feasible to designate a region

of the fuser rollers **332** for non-use. However, the invention contemplates fuser assembly designs in which the fuser rollers **332** have adequate diameters to permit designation of non-use zones. For these fuser assembly designs, the designation and control of a non-use zone would be implemented in a manner similar to those described above regarding the ITB **308** of **Fig. 4A** and the OPC drum **306** of **Fig. 4B**. Briefly, a non-use zone **424** for each of the fuser rollers **332** is designated and controlled by printer driver software **212** that includes a zone module. The printer driver software **212** is stored and executing on either the printer device **102** or host computer **104**, and operates to select the non-use zones **424**. The software **212** ensures that the remaining circumference of each fuser roller **332** is used as a fuser zone during each printing process, and consistently positions the non-use zones **424** toward the exposure gap **422** upon the completion of each printing process.

A final implementation of a zone-protected consumable is illustrated in **Figs. 5A** and **5B**. **Fig. 5A** shows a multi-consumable component assembly encased in a protective housing **500**. The multi-consumable component assembly **502** itself is more clearly illustrated in **Fig. 5B**. The component assembly **502** includes a photoconductor (OPC) drum **504** and an intermediate transfer belt (ITB) **506**. Various print devices are designed to include similar multi-consumable assemblies as such arrangements facilitate the transfer of imaging information between the OPC drum **504** and the ITB **506**.

The protective housing **500** of the multi-consumable component assembly **502** has exposure gaps **508** and **510**. There are no shutter mechanisms for covering up the gaps when the unit is removed from the print device. For both the OPC drum **504** and the ITB **506**, respective regions **512** and **514** have been designated as non-use zones **512** and **514**. These non-use zones will not be used during the printing process to transfer image information. Therefore, during a printing process, as the OPC drum **504** rotates to receive latent color images written with a laser and developed with toner through exposure gap **508**, the printing process skips over non-use zone **512**. Likewise, as the

printing process transfers image information from the OPC drum **504** to the ITB **506**, the process skips over non-use zone **514** on the ITB **506**. When images are transferred from the ITB **506** to paper through exposure gap **510**, non-use zone **514** is also not involved, as it contains no image information.

At the completion of each printing process, non-use zones **512** and **514** are both positioned at respective exposure gaps **508** and **510**. Therefore, the image zones on the OPC drum **504** and the ITB **506** are always protected within the protective housing **500**, despite the lack of a shutter mechanisms to cover exposure gaps **508** and **510**.

Designation and control of non-use zones **512** and **514** is handled in the same manner as described above with regard to the ITB **308** of **Fig. 4A**. That is, printer control logic controls the printing process and the designation and positioning of non-use zones **512** and **514**. Printer driver software **212**, including a zone module, is stored and executes on either the printer device **102** or host computer **104**. The software **212** selects the non-use zones **512** and **514**, ensures that only the remaining image zones on the OPC drum **504** and the ITB **506** are utilized during each printing process, and consistently positions the non-use zones **512** and **514** at respective exposure gaps **508** and **510** upon the completion of each printing process.

In addition to specifically illustrating how designating and controlling non-use zones can protect an OPC drum and ITB single assembly consumable, **Fig. 5** and its description are also intended to illustrate that the invention is more broadly applicable to various multi-consumable component assembly devices. Furthermore, concepts disclosed herein regarding positioning non-use zones to protect the sensitive transfer elements of print device consumables are not limited in application to the described implementations. Rather, these concepts are applicable to any critical imaging component which has sufficient imaging region to permit designation of a non-use zone to be controlled in a manner as described above for the purpose of protecting the remaining imaging region of the component.

Exemplary Print Process Using Zone-Protected Consumables

Having introduced several example print device consumables which can be protected by positioning non-use zones toward exposure gaps in their protective housings, a general print process will be illustrated using such zone-protected consumables. The process described is very general, and only intended to illustrate how zone-protected consumables are used within an otherwise conventional print process such as that described above with regard to the color laser printer **300** of **Fig. 3**.

Fig. 6 is a flow diagram illustrating the general use of zone-protected consumables in a print device. Prior to the start of a printing process, non-use zones are defined or designated on each consumable that has an image transfer region capable of sacrificing a portion of this region to non-use. The designation of these non-use zones is illustrated by operation **600**. A printing process then begins at operation **602**. The printing process is controlled such that image information is transferred only to areas of image transfer regions on each consumable that have not been designated as non-use zones. These areas are the image zones for each consumable. The transfer of image information is shown at operation **604**. The printing process is completed at operation **606**. This indicates that a page or a number of pages from a print job have been output onto a print medium such as paper or a transparency. After a printing process is completed, each non-use zone is positioned toward the exposure gap in the protective housing that encases each consumable, as illustrated by operation **608**. Although there is no shutter mechanism covering the exposure gaps, the positioning of the non-use zones protects the image zones of each consumable. This is especially important if the consumable is removed from the print device between print processes. For subsequent print processes, the non-use zones have already been defined and are therefore not designated again. Therefore, subsequent processes start at operation **602**. This ensures that once an area of a consumable is designated as a non-use zone, it remains a non-use

zone which is consistently positioned at an exposure gap following a print process to protect the consumable.

Although the description above uses language that is specific to structural features and/or methodological acts, it is to be understood that the invention defined in the appended claims is not limited to the specific features or acts described. Rather, the specific features and acts are disclosed as exemplary forms of implementing the invention.